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Process or Product: Constructing or Reproducing Knowledge

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Do students learn when they write research papers? How can teacher-librarians ensure that the experience goes beyond the (often word-for-word) reproduction of knowledge to become a real learning event? A model of thinking developed through a qualitative Canadian study demonstrates, among other things, a relationship between the complexity of student thinking and the process or product orientation of these students. The article discusses how one-on-one interaction between teacher-librarians and students can turn library research projects into positive experiences in which students use a process of constructing knowledge for themselves rather than reproducing knowledge they find in information sources.

Why do teachers assign research papers? What do they expect students to learn from such a project? Do students actually learn those things? A Canadian study investigating higher order thinking skills used by high school students involved in writing research papers (McGregor, 1993) showed that teachers of these students had objectives such as building a basic comprehension level in the content area and analyzing, synthesizing, or drawing conclusions concerning the content. These objectives involved processes of making sense, understanding, learning, and thinking. An assumption made by these teachers (and most teachers anywhere, in my experience) was that researching a topic and writing a paper about it will lead to these desirable results: students would be engaged with their topic and, through a process of seeking meaning, would learn not only about their topic, but would develop expertise in such processes as learning and thinking.

Do students recognize these objectives when they are assigned a research paper? At the task initiation stage, most students in the McGregor study identified building background knowledge and understanding as their teachers' purpose in the assignment. They used phrases such as "furthering knowledge," "get a better understanding," "learn more about the period." One student, however, who did not identify understanding as a goal, felt the purpose was "to get marks in for the report card." Two students were unable to identify any purpose at all in doing the assignment.

Do students have similar purposes or objectives when they conduct research to write a research paper? Although most students in the McGregor (1993) study were aware of their teachers' purposes at the beginning of the assignment, they rarely referred to such goals again. Processes such as gaining understanding, learning something they did not know previously,

preparing themselves to later apply this knowledge to specific situations, learning to use the library, learning to do research, and learning to write essays were identified initially, but were largely ignored or relegated to a subconscious level as students carried out their task. Instead, the students became very product oriented, focusing on what their end product should look like throughout the rest of the process. Some described their reactions to their topics in comments such as: "It looked pretty big. The amount of information that you'd have to put. I guess 1,500 words seems a lot," or "It's basically just ... doing research and finding information and just putting it together in a form."

If the process works the way we, as teachers and teacher-librarians, believe it should, students would learn a variety of things. Pitts (1994) found that "a learning event is composed of a variety of intertwined learning strands" (p. 354), including "the subject-matter strand, the life-skills strand, the information-seeking-and-use strand (which is actually a substrand of the life-skills strand), and the production strand." In an ideal situation, learning would occur on all these strands. Through the model research paper assignment, students might be expected to develop deeper understanding of the content area, improve their abilities to do such things as solve problems or make decisions, increase their ability to locate and use information effectively, and produce an appropriate product (the research paper).

But is this what is actually learned by students in an assignment of this nature? The students in the McGregor (1993) study were not asked to identify what they had learned because, ultimately, learning as an outcome was not the focus of the study. Had this question been asked, it is likely students would have identified content learning, because the paper was assigned in a content-based class (either English or social studies) and the original expectation of students and teachers was that content would be learned. It is also likely that whether or not learning occurred on the other learning strands, students would not have recognized it, except possibly in the area of learning to use the library or learning to do research. It is questionable, however, whether much new learning occurred in terms of processes, because the students involved had considerable previous experience with libraries and doing library research. They conducted their search confidently, using prior learning in the area, rather than trying out new techniques, investigating new possibilities, or evaluating their process for its effectiveness. The learning that had occurred previously, based on earlier experiences with research paper assignments and libraries, was clearly reinforced: how to format and organize a research paper, how to search a computer catalog, how to use an index, where to access information when the school library sources were deemed to be inadequate. In the realm of using the information accessed, unfortunately, a previously learned, product-oriented skill was also reinforced: that of copying from the original information source and putting the copied portions together to produce a coherent product.

The Model of Thinking During Information Use

The findings discussed here were produced in a qualitative research study of higher order thinking skills utilized during information seeking and use (McGregor, 1993). The study involved 34 grade 11 students (typically 15 or 16 years old) in two International Baccalaureate classes, working on English and social studies research papers. The study resulted in a model of the thinking process in this context (Figure 1). Although the study cannot be generalized to a larger population, because the sample studied was small and nonrepresentative, the model provides insight into the way thinking seems to be conducted during an assignment requiring students to produce a research paper. The model also provides empirical support for some beliefs held by many practitioners in the field of school libraries. This article focuses on the element of the model that deals with process/product orientation, but a brief discussion of the entire model is necessary to place that orientation into a context.

The model shows five characteristics of thinking in the context of solving an information problem and demonstrates how these characteristics are interwoven and interdependent. The *intuitive approach* to solving an information problem pervaded all areas of the thinking process used in relation to this problem. The model shows this approach encompassing the entire pro-

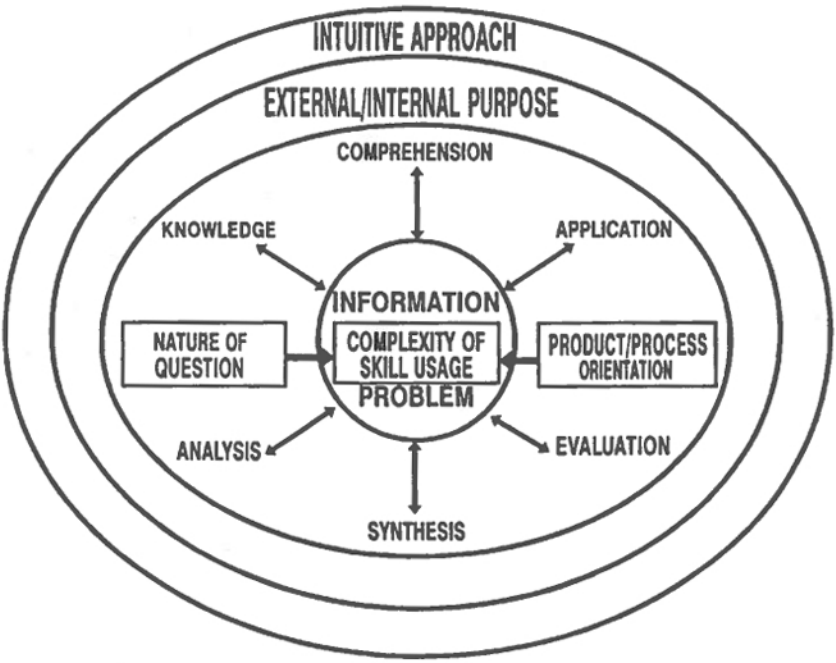

Figure 1. Model of thinking during information use.

cess of dealing with an information problem. The cognitive operations of the information user appear to be conducted without any awareness of the process. Students were often not aware of the thinking they were doing, and were not conscious of ways in which they could alter their thinking to be more productive. They often operated from a belief that the process of thinking was a mystical, unexplainable phenomenon, one that had almost magical qualities. Thinking either happened or did not happen, but was not under their control.

The second ring on the model, in the intuitive approach, is the external/internal purpose to thinking, a dichotomy that consists not of two opposable elements, but two kinds of purposes that are often carried out concurrently. External purposes of thinking are served when thinking deals with matters outside of the actual information found in the information sources, outside of the subject matter. This meant that thinking was carried out that resulted in such things as analyzing and evaluating a source of information or evaluating sentences and paragraphs as the writing progressed to determine their effectiveness in the research paper. Internal purposes for thinking involved the thoughts that took place about the content in the sources, thinking about the subject matter, analyzing facts, and evaluating ideas. In the intuitive approach to thinking, these external and internal purposes were not distinguished one from another by students and teachers.

All cognitive skills described by Bloom's taxonomy (Bloom, 1956) were evidenced to a greater or lesser degree throughout the process of information seeking and use. Originally, the research was focused on only the higher order thinking skills (*analysis, synthesis,* and *evaluation*), but it was impossible to discuss the higher order skills without reference to the basic skills (*knowledge, comprehension, application*), as they all were used or needed throughout. These skills, applied intuitively, and at different levels of complexity by different students, were utilized in the information problem in both an external and an internal manner.

The complexity of skill usage in the information problem was related to two identifiable aspects of the situation: the nature of the original information question and the product/process orientation of the students. One research paper assignment in the study involved an analytical question and the other a factual question. Although higher order thinking skills were used at various stages in both assignments and by all students, more complex skills were used in the assignment based on the analytical question. More complex thinkings skills were also used by students who showed some degree of process orientation.

Process or Product?

The model contains little that is very surprising to practitioners. Generally, it provides support for things that teacher-librarians have been saying all

along. The one area that appears to raise many further questions is in the product/process orientation of students. The McGregor (1993) study found that students had varying orientations toward process and product. Not surprisingly, thinking in the context of conducting library research for writing a research paper was found to be product-oriented. It is not surprising that the students, being International Baccalaureate students, cared about the product they composed. Most students, however, showed no orientation toward anything else. The only time most students exhibited an awareness of process was when they were asked to consider what the purpose of the research assignments might be. At that point, they were conscious of processes that coincided with the teachers' objectives, such as understanding, learning, and thinking, but as they carried out their tasks, they disregarded most thought about these processes while they focused on the product. Product orientation began when students learned what their topics were and reacted to them. Even those who disliked their topics were motivated to do a good job of writing the paper. Throughout the search phase, most students indicated that the real work and the real thinking would take place when they began to write the paper or create their product. They viewed the information gathering stages as preliminary, not involving much thinking. This belief was demonstrated most dramatically by the student who commented: "I was brain dead that day and all I did was collect information." They believed that the most important thinking they would do would take place when they put the information together to create the product. They had a clear perception of what the end product should look like, and most of their thinking was directed toward making their product fit that mold.

A few students, however, were different. They showed evidence throughout the assignments' duration of a focus on a variety of processes, such as learning, thinking, sense making, or seeking meaning. The students who evidenced some process orientation showed more involvement in a process of making sense for themselves, of transferring information into long-term memory. Their goal was not only to produce a satisfactory product; it was also to process the information they were encountering to deepen their understanding of the topic. They were more likely to internalize their subject than those who were more narrowly oriented toward simply completing the assignment in such a way that it "looked good." The process-oriented students seemed to recognize that learning should be a result of their process. They referred more frequently to understanding their topic. They were involved in a process of discovery and the product that was a result of it, though important, was not their only concern. One process-oriented student talked about discussing her topic with other people: "I have to talk out my ideas in order to understand what I'm thinking" (student quote). Another described reflecting on the topic at times when not actively working on the assignment:

> As I was eating breakfast I was thinking about the revolution and I was thinking that ... a historian ... was against the revolution because it moved too fast, and I'm going to expand on that, such as events that might not have happened, such as the king might have been more complacent if the Revolution moved slower, he might not have tried to flee the country. (student quote)

Those students who demonstrated some degree of process orientation also showed evidence of using more complex skills of analysis and synthesis. Students who demonstrated no process orientation spent most of their time categorizing and sequencing, which are analytical skills, but are less complex than those used by the process-oriented students: comparison, discovery of cause and effect, inference, prediction, use of analogy.

In examining how the students with different process/product orientations differed from each other, an interesting observation emerged. The students who were focused solely on product tended to copy from the original sources. The degree of copying ranged from almost none to 93% of the paper being copied word for word. Interestingly, the papers of students who showed some degree of process orientation at some point during the study did not show evidence of copying. It appeared that students who endeavor to understand new subject matter, to interpret information, to seek meaning in what they are reading are able to put that information together in a new way, rather than relying on the words of the author of the source in which they found their information. Whether this ability is related causally to their tendency to think at a higher level cannot be determined from these data. What is clear, however, is that these students showed awareness of a variety of processes that educators assume to be integral to learning, that they exhibited more complex thinking skills than did those students who showed no process orientation, and that they did not copy from original sources.

Constructing Knowledge

What is different about these students? Have they had different experiences than the other students that have made them more aware of learning processes? Have they been taught to think differently than other students? The processes they demonstrated—learning, researching, thinking, making sense, seeking meaning—all can be thought of as elements of the greater process of constructing knowledge or mental understandings. When students think about what information they will need to locate and then about the information they encounter as they attempt to produce a research paper, they strive to make sense of what they read, search out meaning as they add knowledge to the understanding they already possess. They construct knowledge. They learn. Each forms a construction different from that of any other student, because the individual's construction is integrated with previous learning and experience, all of which are highly specific to the individual.

These students expand their learning on all the learning strands, not just the production strand. Pitts (1994) suggested that students are unaware of the various intertwined learning strands that coexist in a learning event. The students in the McGregor study who showed awareness of processes beyond the construction of a product (the production strand) would be likely to identify the fact that content learning (the subject matter strand) was taking place. Like most of the other students, however, they saw the entire process of thinking as an intuitive operation, and probably saw the process of learning in the same way. Even though they were practicing their life skills such as "decision making, problem solving, taking responsibility, planning, and communicating" (Pitts, 1994, p. 119) and very likely improving their abilities in these areas, as well as in the area of information seeking and use, they were unaware that they were constructing their own understanding of these skill areas. The process oriented students were gaining experience and expanding their ability to use the life skills and the information-seeking-and-use skills in relation to both the subject matter strand and the production strand, whereas the students who were strictly product oriented were developing their life skills and information-seeking-and-use skills in relation only to the production strand.

Resource-based learning, and specifically the research paper assignment, has potential for encouraging effective construction of knowledge by students. Because the idea should be to examine a variety of sources that will encourage "students to confront their own ideas and reconstruct their understandings" (Pitts, 1992, p. 19), the opportunity for expanding mental models or beginning to build new ones exists. For teacher-librarians and teachers, the challenge becomes to determine what types of experiences during the learning event will provide the most effective support for the student trying to construct knowledge on all learning strands in the context of solving an information problem and writing a research paper. How do teachers and teacher-librarians provide the scaffolding necessary to move students beyond a simple product emphasis to a focus on learning on the other learning strands? How are they challenged to confront their own ideas?

The constructivist approach to learning has a great deal to lend to this area of learning theory. Because each student constructs an individual pattern of knowledge based on prior learning, providing identical instruction to all students is unlikely to lead to the most effective results. Individuals will have different needs, different learning gaps, and different mental models of the subject matter and the task. The standard group instruction about useful sources of information—often tuned out by students anyway—will be helpful to only a few and is probably wasting the time of the other students. Indeed, the negative impact of sitting through instruction not viewed by students as helpful may do more harm than good.

The Teaching Role

Follow-up interviews with the teacher-librarian involved in the McGregor (1993) study (Ms. X) led to some thought-provoking ideas in the area of appropriate instruction in this context. Ms. X had previously worked as teacher-librarian in elementary schools, and was employed in a high school library for the first time. The data collection for the study began at about the same time she began her employment and provided many opportunities for her to discuss her observations, comparing the kinds of things that were happening in the high school with the elementary schools with which she was familiar. Typically, her comments were related to the lack of engagement by the students, not just those participating in the study, but many students of all abilities involved in library research. She was concerned that these students showed little expectation of learning anything through the assignments they were given. Furthermore, they were not being provided with appropriate guidance or scaffolding from their teachers to expand their mental models of their subject matter or their task.

> I observed that generally when kids [at high school level] were doing research, they went on automatic pilot, that they wanted to just get on with the job. "Give me the books and get out of my way" kind of thing. I guess my observation [was] that teachers, for the most part, had the same expectation, that they could sort of step back and that the students would go forward and do what it was that they needed to do.[1]

She found that when she offered the kind of introductory lesson expected by the teachers, in which she introduced concepts about doing research ("a good idea when you begin with a book is to look through and see how it's organized") and introduced particularly pertinent sources they might consider using, students for the most part spent that time politely waiting for her to finish so they could go about the task the way they had always done before. She became frustrated with the seeming futility of these introductory lessons and began to look for different ways to engage students with their topics.

One-on-one interaction proved to be the most effective support Ms. X could provide. She stated:

> If I could make some attempt to open up some kind of a conversation with students, and that wasn't always easy, but if I could do that, then I found both the student and myself enjoying the process a great deal more. And I found that with the students that I was able to open a dialogue with, the research that they were doing went beyond the kind of automatic process, because I found them coming back to the library and asking for more assistance, outside of class time. I found them coming back with their product and showing that to me. I found them sort of carrying on a further interest in what was going on. But I also found right during the process of doing the research that they would come and ask for assistance to find a source, or how to use a source, or even interpreting.

She was able to provide the particular scaffolding needed by each individual because she had "opened up a conversation" with individuals. She was able to learn what that particular person needed, where his or her understanding showed gaps, where the mental model needed expansion, whether it was related to learning on the subject-matter strand, the life-skills strand, the information-seeking-and-use strand, or the production strand. The value of this type of conversation was recognized by the student mentioned previously who felt that she needed to talk out her ideas with someone (frequently her father) in order to understand what she was thinking.

Ms. X acknowledged that students did not expect to be "interfered with." They were prepared to be independent and were accustomed to going their own way. But, as she gained experience through the year, she found that she was able to become more assertive in her approach to individual students. She said, "I guess through my experience doing research with elementary students, I really found the need to help students think about what it was they were looking for, and then help them find and interpret what they were looking for, and help them organize that information." The more she carried out this kind of one-on-one interaction, the more she felt the students became engaged with their topic, showed an interest in the assignment, and tried to make sense of the information they were trying to use.

When an entire class receives identical group instruction, each student receives and incorporates the information in a different way. Some will be able to benefit from the instruction, but it is quite possible that many will not. Those students who are paying close attention will fit the new information into different places in their mental models, depending on their prior experience and knowledge. The general objectives of the teacher may or may not be met with those individuals. If gaps existed that did not coincide with the information provided, the mental models might be expanded inaccurately. The fact that this had happened would never be discovered, due to lack of one-on-one interaction. Those students whose attention is not engaged by the lesson—and any thoughtful teacher-librarian is aware that this number may not be just a few—will probably not make any meaningful adjustments to their mental models.

Students who are highly product oriented and not engaged by their topic or the assignment probably construct mental models very different from those the teacher expects. These mental models may focus on the best ways to reproduce the knowledge contained in the sources presented so that the reproduction of knowledge answers the original question to the satisfaction of the student. The students in the McGregor study were told that they would be graded on whether or not their product contained "sufficient thought and detail in it, rather than you just reproducing somewhat blindly, without any thought, something that you have read, or whether you've read it, thought about it, and then written it in your own words" (quote from an English teacher in McGregor, 1993, p. 69). However, in actual fact, overall,

the grades received by the students who did little more than reproduce the knowledge they found in their sources of information were higher than the grades of those students who actually constructed new knowledge for themselves. The mean score for students who had copied at least 30% of their English papers was 85.2%, whereas the mean score achieved by students who had copied little or none of their papers was 76.4%, a difference of almost 9%.

Figure 2 shows a comparison between process oriented and product oriented teaching. No causal relationship has been empirically established between any of these elements, so it is not possible to make a definitive statement regarding what must take place between teacher-librarians or teachers and students writing research papers. However, when applying the concepts of constructivism to this context and relating them to the experiences and observations of Ms. X, the teacher-librarian in the McGregor study, a pattern appears. One-on-one interaction between teacher-librarians and students, or teachers and students, allows an opportunity for students to explore their particular mental model and identify the gaps. The active involvement required during this dialogue could result in the student becoming more aware of processes of making sense and seeking meaning, then thinking about that meaning and learning from it. Because the instruction would involve a different dialogue with each student, the instruction would be more pertinent to the needs of the particular student. The end result could be a more effective construction of knowledge.

ORIENTATION	Process	Product
STRATEGY	Construct knowledge	Reproduce knowledge
INTERACTION	One-on-one	Group instruction
INSTRUCTION	Different for each individual	Same for everyone
STUDENT INVOLVEMENT	Active	Passive
END RESULT	Construction	Reproduction

Figure 2. Process orientation vs. product orientation.

In contrast, a product oriented teaching situation provides the same instruction to everyone in the group. When instruction consists solely of the teacher-librarian standing in front of the group and lecturing about sources or the expected research process, students take a passive role in the process. The chances are much greater that they will continue to reproduce the knowledge they find in the sources, and will have a strong product orientation. The result is reproduction of existing knowledge, with little learning taking place.

This is not to say that group instruction should never occur. Lecturing to a passive audience is not an effective way to encourage construction of knowledge, however. Von Glaserfeld (1993) maintains that, because knowledge is built by the learner, it cannot simply be transferred to a passive receiver. Those who learn from a lecture situation actively deal with the information they receive in order to assimilate the knowledge into an appropriate place in the existing mental model. Unless the lecture situation requires active participation—discussion, time for reflection, and opportunities to try out the ideas (Bettencourt, 1993)—many students simply will not become actively engaged but will patiently wait till the lecture portion is over in order to go about the task the way they have always done it before—by reproducing the knowledge of others.

Construction of knowledge can occur in groups. However, it is important to recognize the kinds of activities that lend themselves to co-construction of knowledge. Because active engagement is required, brainstorming and idea-generation are effective ways for students to build on the knowledge of others while constructing and revising their own mental models. But after the ideas have been generated, students need to work independently on their own individual conceptions. "Once the brainstorming has yielded promising ideas, however, research and observation suggests that planning and synthesis are often best performed by individuals" (Linn & Burbules, 1993, p. 92). Now it is time for independent work by the research paper writer, with one-on-one guidance provided by the teacher-librarian and teacher.

Must these professionals constantly talk to each student on an individual basis, monitoring their every thought and step? Constant interference (and that is what too much dialogue would be) would be counterproductive; not only is there not enough time for the adults involved to spend discussing every point in detail with each students, but students do not construct knowledge effectively if they do not struggle to solve a problem themselves. And the nature of the problem makes a difference too. Students will be more willing to struggle with a problem of their own choice than one provided by someone else (von Glaserfeld, 1993). As the model of thinking (Figure 1) demonstrates, the nature of the question is related to the complexity of the thinking skills used.

To find the right balance of dialogue and noninterference, the teacher-librarian and teacher must determine what the purpose of the conversation

might be. Helping students who ask for help is an obvious purpose to carry out. However, many students will not ask for help, or indeed recognize that they could benefit from help, especially when they have been previously unaccustomed to the constructivist teaching style. Sensitivity is required by the adult who wishes to "interfere" at the right moment. The teacher-librarian or teacher must attempt to construct for himself or herself a model of the particular student's own thinking. Asking a student how he or she arrived at a conclusion can lead to an opportunity to analyze the student's thinking (von Glaserfeld, 1993, p. 33). A question based on an external purpose of thinking (see Figure 1), such as the particular source the student has chosen and the basis for choosing it, might open a discussion about the thinking that is internal, related to the subject matter. A simple question, a hint about a possible direction in which to go, or feedback on a line of thought or the usefulness of a particular source can provide an opportunity for deeper discussion and extension of the zone of proximal development—the difference between the level of learning a student can achieve alone and the level of learning he or she can attain with the assistance of someone more capable, typically an adult (Vygotsky, 1978). As Ms. X said, when she opened up a dialogue with a student, that student was often more willing to ask for help and seemed to develop more interest in the assignment. The focus moved away from being totally product oriented (although product questions were often asked) to involving some process of seeking meaning and making sense. The learning that occurred with the help of an adult was more than would have occurred had the teacher-librarian not initiated the dialogue. She stated, while talking about students in general, not just those involved in the McGregor (1993) study: "I often found that the students who worked with me in that way were students who maybe have difficulty reading the sources and recognized that difficulty and wanted to understand what they were reading." However, this request for help came only after the original conversation was initiated by the teacher-librarian.

We began this discussion with a question concerning the purpose of research papers and the learning expectations held by teachers assigning them. If teachers and teacher-librarians expect learning to occur on any or all of the intertwined learning strands, then students cannot be abandoned to fend for themselves. Nor can we assume that group instruction alone will provide all the tools and skills everyone will need. The project must be seen as a golden opportunity to engage each student in construction of learning. As Ms. X said,

> I guess I really have to question why we do these projects with students if we don't see those as teachable moments? ... I really believe that students need to know why they're doing what they're doing and they have to be really aware, in terms of their own thinking and in creating some meaning for themselves.

For process learning to occur and for a process orientation to develop in students, we must initiate these conversations with students. We need to

provide them scaffolding that will assist them to learn on all the learning strands. Teachers and teacher-librarians at every grade level must be careful to give students as much support as they need, making no unfounded assumptions about students' abilities to think at appropriate levels (McGregor, 1994). We must turn these product oriented assignments into a chance to assist novice learners to become experts at the process of constructing knowledge rather than reproducing it.

Notes

[1]Quotations from Ms. X, the teacher-librarian who participated in the McGregor study, were received in a personal communication, October 14, 1994.

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